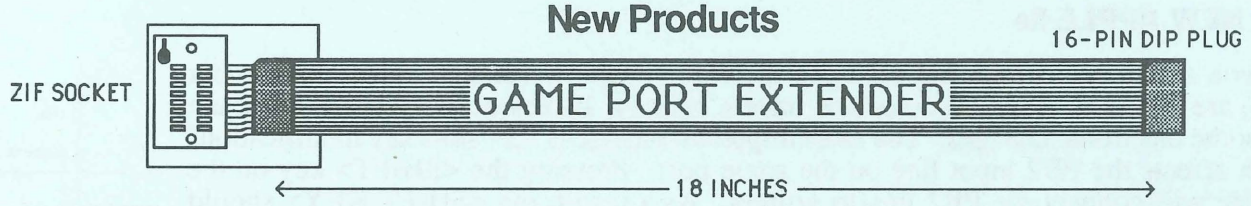
# Vernier Software Newsletter

Volume 4 Number 1 Spring 1987

## In This Issue:



## New Products




We are now selling an extension cord for your Apple II Plus/IIe/IIGS internal game port. With our game port extender, you will never have to get inside the computer to connect devices to the game port. The extender is 18" (45 cm) long. It has a "zero insertion force" (ZIF) socket on the end. With this socket you place the pins in the holes and then move a lever to clamp onto the pins. This greatly reduces the chances of bending the pins. It also saves on fingers. Double-sided tape is provided for attaching the external socket to the side of the computer, desktop, etc. Our game port extender sells for $16.00 (includes shipping).

### SMART PULLEY TIMER

In a way, this is not really our product. We recently wrote a special timing program that is being sold only as part of PASCO scientific's "Smart Pulley Mechanics System." The package includes a photogate with a low-friction pulley that mounts inside it, an extensive "student-ready" manual, several accessories and our SMART PULLEY TIMER program. This is our first ProDOS interfacing program. It has our new "user interface" and improved graphics. The data collected are compatible with AppleWorks and GRAPHICAL ANALYSIS III. The program includes real-time displacement or velocity graphs and continuous display of velocities. The Smart Pulley Mechanics System is available only from PASCO scientific, 1876 Sabre St., Hayward, CA, 94545 (800)772-8700. The complete package sells for $195.00.

## Compatibility Reports

### APPLE IIGS - GOOD NEWS AND BAD NEWS

All of the programs run fine on the IIGS.[1] Our laboratory interfacing programs (PRECISION TIMER II, FREQUENCY METER, TEMPERATURE PLOTTER, VOLTAGE PLOTTER and SMART PULLEY TIMER) and the programs on the *Project Programs* disk of *How to Build a Better Mousetrap* should be run with the IIGS set on "NORMAL" speed. In our last newsletter we said there might be a problem using the PB2 input line. That is not the case; all of our hardware works on the IIGS. That is the good news.

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[1]Old versions of our FREQUENCY METER program may not work. We offered a free upgrade in the last newsletter. This offer still stands. If you find that your version of FREQUENCY METER will not work on the IIGS, send us the original disk and we will send you a free new disk.

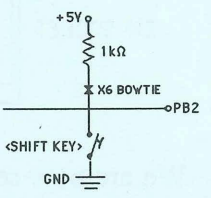
And now the bad news...

The IIGS is not as "forgiving" as the Apple IIe or II Plus. In eight years of building and testing devices that plug into Apple II Plus and IIe game ports, we have never damaged a computer. Believe me, we have had lots of wiring errors, shorted wires, plugs in backward, etc. Within two months of getting our IIGS, we had a problem. The PB0 input line no longer worked (it acted like the "pull-down" resistor was missing). There is no way to fix a IIGS except to get a new motherboard ($234.00). We think the problem occurred when we dropped a photogate system we were testing and shorted out some of the wires.

I have talked to Apple technical support about this. Their response is that it was never a design consideration to make any computer able to tolerate wiring errors. They say the game port was designed to be used with assembled, tested input devices. I guess we were all very lucky that the Apple II Plus and IIe are so durable.

Ideally, you will never make a mistake when you are building devices to connect to the game port. Realistically, you or your students will make an occasional mistake. Our advice regarding the IIGS: **We do not recommend using the IIGS for "do it yourself" laboratory interfacing.** Use a IIe or II Plus instead. If you do use a IIGS, do so very carefully. If possible, test all devices on a IIe or II Plus before plugging them into a IIGS.

## THE NEW APPLE IIe




Are you aware that Apple has changed the IIe? The new versions (since November 1986) are platinum (gray) in color and have a built-in, 10-key numeric pad. There are also some electronic changes. The most important change is the "shift key modification" which affects the PB2 input line on the game port. Pressing the <SHIFT> key on the new IIe will connect the PB2 line to ground. As a result, the <SHIFT KEY> should never be pressed while you are using any device connected to the PB2 input on the game port. The PB2 input line on the new IIe is also connected to the +5V power supply lead via a 1-kΩ resistor. This forces a hardware change in two projects in our book *How to Build A Better Mousetrap*. Also, the Microphone/Amplifier for use with FREQUENCY METER must be changed to work on the new IIe. The necessary changes are explained in the "Program Enhancements and Suggestions" section of this newsletter.

## LASER 128

All of our programs except PRECISION TIMER II and TEMPERATURE PLOTTER will run on the Laser 128. We now have a special version of PRECISION TIMER II which we can send you (free, if you are a registered owner) that will work on the Laser 128.

## TRACKSTAR ON AN IBM COMPATIBLE COMPUTER

We recently spent several days using a Tandy 1000SX computer with a TRACKSTAR board installed in one of the slots. The Tandy 1000SX is an IBM compatible computer that normally operates in the MS-DOS system. With a TRACKSTAR board added, it can also function as an Apple II using either DOS 3.3 or ProDOS. The TRACKSTAR board even provides both 9-pin and 16-pin "Apple IIe" game ports. We were impressed with how Apple compatible the Tandy 1000SX/TRACKSTAR combination was. All of our programs ran; two programs (GRAPHICAL ANALYSIS III and VECTOR ADDITION II) required minor modifications before they worked correctly. We were able to use the built-in disk drive on the Tandy 1000SX. Even more surprising, all of our hardware (except the Advanced Interfacing Board) worked when connected to the TRACKSTAR game ports.

The TRACKSTAR board will work in other IBM compatible computers. One possible limitation: we do not know if it is possible to make paper copies of the high-resolution graphics produced on the screen (for example a graph created by GRAPHICAL ANALYSIS III).

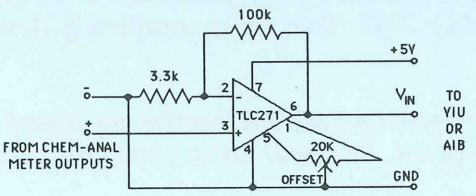
The TRACKSTAR board is sold at Radio Shack Computer Centers ($395.00). If you purchase one of the boards, contact us for details about the modified versions of the two programs that required changes.

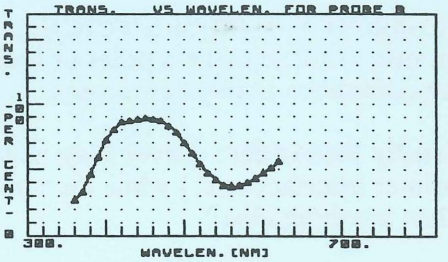
# Program Enhancements and Suggestions

## VOLTAGE PLOTTER

◊ Remember that VOLTAGE PLOTTER can be used with any transducer or instrument that produces a voltage output that is linear with respect to the signal being measured. There are lots of possibilities that we did not mention in the manual. Here is one that works very nicely:

Jim Dyer of Oregon Episcopal School needed a way to efficiently collect data from a Sargent-Welch ChemAnal Spectrophotometer. The unit has banana plug output terminals. The potential between these plugs varies in proportion to absorbance over a range of about 100 mV. The amplifier circuit shown below can be used to step up this voltage and send it to our Voltage Input Unit or Advanced Interfacing Board. Mode K of VOLTAGE PLOTTER provides a neat way to collect data for an absorption spectrum. The graph was produced by VOLTAGE PLOTTER. It is the absorption spectrum of a solution containing complex nickel ions.



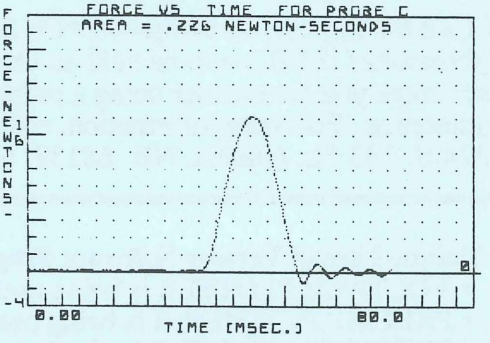

◊ In the VOLTAGE PLOTTER manual the TLC271 is suggested as one possible op amp to use for the pH amplifier project. Don't use it–use an LF356N, TL081, or another BiFET op amp.

## ADVANCED INTERFACING BOARD

◊ A Free Upgrade Offer: We have recently spent several weeks improving the manual and sample programs disk that accompany the Advanced Interfacing Board. The new manual is very much more "user friendly." Reading an analog voltage can now be done with one BASIC statement. If you have purchased our board, we will send you a new manual and disk if you return the original sample programs disk.

◊ If you are using our Advanced Interfacing Board, keep in mind that our game-port extender ($16.00) can also be used to extend the I/O socket from the board to the outside of the computer.

◊ Mark Schindler from Honolulu Community College has gotten some very good results using PASCO scientific's Force Transducer and our Advanced Interfacing Board to study collisions. He even uses PRECISION TIMER II to measure the speeds of the glider before and after the collision. One of Mark's sample graphs is shown at the right.[2]




### *How to Build A Better Mousetrap*

If you have our book of science projects involving the Apple II Plus/IIe, make the following corrections to your copy:

**Introduction**: ALL Electronics has a new address: P.O. Box 567, Van Nuys, CA 91408 and a new toll free number 1-800-826-5432.

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[2]By the way, we have recently produced a new prototype version of VOLTAGE PLOTTER which allows triggering using a photogate connected to the game port. This version would be useful for this kind of experiment. Let us know if you want to try it out (if you own VOLTAGE PLOTTER).

**Project 4 - Humidity Meter**: The number in the equation on page 4-11 should be 0.985 instead of 0.0985.

**Project 9 - pH Meter**: The part number of the op amp which Digi-Key sells is LF356N, not LM356. Also, if you are having trouble locating a BiFET op amp for this project here are some other part numbers to try: 355, 355A, 356A, AD544L, TLO71, TL081, LFT356. Note that the only BiFET op amp that Radio Shack sells (TL082) is a dual op amp. The pin connections are not the same as explained in the book.

**Appendix A**: If you plan to use a Radio Shack Joystick Extension Cable to make a 9-pin cable for a project, please note that they have changed the colors of the wires. The color code listed on the bottom of page A-2 is no longer correct. The diagrams on that page are correct. Use an ohmmeter to determine which line goes to which pin of the plug.

**General**: Using the projects with new (platinum color) Apple IIe:

The "shift-key mod" on the new IIe requires a change in two of the projects:

**Project #1: Photogate Timer:** Use a 330-Ω resistor in place of the 3.3-kΩ resistor. This should produce a working photogate. If you make this change the photogate will work only on the new Apple IIe. A better alternative is to build the Schmitt Trigger photogate suggested in the project extensions. This photogate will work on any II Plus, IIe or IIGS computer.

**Project #3: Microphone/Amplifier:** Use a 330-Ω resistor in place of the 2.2-kΩ resistor. Also, add an additional 330-Ω resistor between the PB2 input line and the GND line. This modified circuit should work on any Apple II computer.

**Project 4 - Calibration of Humidity Sensors**

Project 4 of is a relative humidity meter based on a sensor that changes capacitance. The sensor works well and provides reasonably accurate results (+/- 5% or so). The hard part of this project is checking the calibration of the final circuit. How do you determine if it is working correctly over a range of relative humidities? Here is a saturated salt solution (pun intended):

Place a small amount (~1cm) of water in a small, wide-mouth (~1 liter) jar. Add enough of one of the salts listed in the table below to make a saturated solution. There must be extra, solid salt in the jar. Place the circuit with the humidity sensor inside the jar so that the sensor is close to the solution. Seal the top of the jar with plastic and a rubber band. Run the HUMIDITY program on the *Project Programs* disk. After about five minutes the sensor should have had time to adjust and the program should be reading the humidity listed in the table. For best results, pure water and salts are recommended, but we have gotten good, consistent results using tap water and even table salt for NaCl.

| Saturated Salt Solution | %RH at 20°C |
|---|---|
| $MgCl_2$ | 33 |
| $Mg(NO_3)_2$ | 53 |
| NaCl | 75 |
| $BaCl_2$ | 90 |
| KCl | 85 |

Warnings:
(1) Some of these salts are poisonous and/or can cause skin irritation.
(2) Don't let the sensor fall into the salt solution; it may be damaged.

## FREQUENCY METER

The Microphone/Amplifier circuit described in the manual will not work on the new (platinum) Apple IIe. To use the circuit on the new IIe make the following change:

Use a 330-Ω resistor in place of the 2.2-kΩ resistor. Also, add an additional 330-Ω resistor between the PB2 input line and the GND line. This modified circuit should work on any Apple II computer.

## TEMPERATURE PLOTTER

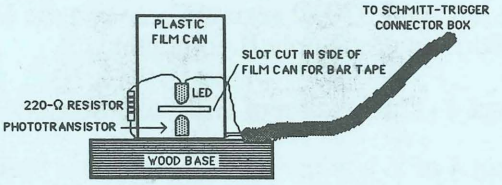
◊ We have changed to a clear, polyolefin heat-shrink tubing for sealing the ends of our temperature probes. This new tubing is somewhat more durable in chemicals than the black, heat-shrink tubing we had been

using for about a year. The new tubing holds up well in most common chemicals used in school labs. It does not survive very long in acetimide, cyclohexane, lauric acid, naphthalene (moth balls), or toluene. Ironically, some of these chemicals are popular for "cooling curve" experiments. When using our probes in these chemicals we recommend placing the probe inside a narrow test tube. This will protect the probe. The only disadvantage is that the glass will insulate the temperature sensor, making it somewhat slower to respond to temperature changes.

◊ If you have temperature probes that are not working properly, the most likely source of the trouble is liquid inside the probe. Try taking the probe apart, dry it out and reseal with silicone sealant (for example, GE Silicone II Household Glue and Sealant). If this does not solve the problem, please contact us and we will try to help you solve the problem.

◊ If you really want a super-durable temperature probe to use with TEMPERATURE PLOTTER, remember that Analog Devices[3] sells stainless steel temperature probes with AD590 temperature transducers built into them. We have purchased one for testing. It works just like one of our probes, except it responds even faster to temperature changes and it should withstand almost any chemical. All you need to do is solder a miniature stereo phone plug on the end of the cable and plug it into one of our temperature probe boxes. Unfortunately the probes cost about $50.00 each. The part numbers are AC2626xy (the "x" specifies the grade, and the "y" specifies the length of the tube - 4 or 6 inches). We got good results with AC2626J4.

## PRECISION TIMER II




◊ William Soule of Weymouth North High School has developed an interesting photogate alternative which has lots of applications. He mounts the LED and phototransistor inside a plastic 35mm film. He then cuts slots in the side of the can so that he can pull "bar tape" through the can between the LED and the phototransistor. For bar tape he uses Chartpak graphic tape backed with Scotch Magic Transparent tape. Mode M of PRECISION TIMER II can be used to collect the times between leading edges of the bars. Displacement, velocity or acceleration graphs can be made for any motion of the tape. This can be used to study free fall, in acceleration labs or in any lab where a "ticker-tape timer" is traditionally used. It is also an inexpensive way to do some of the new labs in the new version of the PSSC lab book.

◊ The December 1986 issue of *The Physics Teacher* had an article by Robert Theriault about using toy cars to stimulate interest in mechanics. PRECISION TIMER II and the device described above would be a nice way to do this type of experiment.

## GRAPHICAL ANALYSIS III

◊ The special input routine that we use in GRAPHICAL ANALYSIS III to allow use of keystrokes such as <CONTROL><Y>, and <CONTROL><E> during data entry can cause some problems. For example, it will not always work if you have something connected to the game port. You can eliminate the use of this routine by changing line 2055 of the BASIC program PART.ONE to read:

```
2055 PRINT CHR$(4);"BLOAD INPUT.IIPLUS"
```

Save this change and reboot the program. It will function normally, except only the data entry keystrokes that are supported on an Apple II Plus will work (<LEFT ARROW>, <CONTROL><X>, <CONTROL><Y>, and <ESC>).

◊ If you got your copy of GRAPHICAL ANALYSIS III in December or early January, we have made a few minor improvements. The biggest change has to do with the way the length of error bars are calculated on modified graphs. Look at the version date in the first few lines of the BASIC program. If it is before 1/22/87, we will send you a free update if you send us your original disk.

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[3]Analog Devices, Inc. sells their products directly, not through distributors like most electronics manufacturers. They have branches in many cities. To find out about the nearest branch, call (617) 329-4700.

## Miscellaneous Information

◊ **Program Registration Cards**: Why bother with those program registration cards? We know you get tired of filling out product registration cards and it may seem that they serve no purpose. But we really do use them! Some issues of our newsletter are sent only to known purchasers of our programs (anyone who purchased directly from us or who sent in the program registration card). We often offer free upgrades or free special versions of our programs to all known purchasers (there are four examples in this newsletter).

◊ **Student Lab Book for Mechanics Labs Using a Computer**: Linda Huetinck has written a laboratory manual covering 32 investigations involving: free fall, friction, pendulums, collisions, angular momentum, etc. The manual is ready for student use. It leads the student through the process of using PRECISION TIMER II and photogates connected to your Apple II to collect and analyze data. A teacher's guide is also available. For further information or to order contact: J & L Enterprises, P.O. Box 6195, Alhambra, CA 91802, (818) 570-9767.

◊ **Special "Computers in Physics Teaching" Issue**: If you are not a regular subscriber to *The Physics Teacher*, you may want to make a point of looking at the May 1987 issue. It is completely devoted to the topic of using computers in physics classes.

◊ **Just a Friendly Reminder**: Never plug in or unplug any board (Advanced Interfacing Board, disk drive controller, printer interface, etc.) while the computer is turned on. We hear about problems caused by this more often than anything else.

◊ **Changing the "SYSTEM SPEED" on a IIGS:** As we have said before in this newsletter, our laboratory interfacing programs must be run at NORMAL system speed on the IIGS. If you are using the programs only on a IIGS, there is another alternative that you might want to consider. Only the sections of the programs that actually do the measurement must run at the NORMAL speed. If you are willing to do some program customization, you can have the program change the system speed so that it runs at NORMAL speed for the measurement and at FAST speed for graphing, data tables, etc. The BASIC lines to add are:

```
VS = PEEK (49206): IF VS > 127 THEN POKE 49206, VS - 128 : REM SETS SYSTEM SPEED 'NORMAL'
VS = PEEK (49206): IF VS < 128 THEN POKE 49206, VS + 128 : REM SETS SYSTEM SPEED 'FAST'
```

This change works in either DOS 3.3 or ProDOS. We will probably use this in future versions of our programs to take advantage of the extra speed of the IIGS.

**A Call for Papers**: A Symposium On Science Education and Technology-Microcomputer Based Laboratories (MBL) is to be held on October 29-31, 1987 near Omaha, Nebraska. We have been asked to encourage you to consider being a presenter, workshop leader, or demonstrator at this first of a kind conference. For more information, contact John Rogers, Science Center, Educational Service Unit #3, 4224 S. 133 St., Omaha, NB 68137, (402) 330-2727.

◊ **Unique Uses of Vernier Software Programs:**

- VOLTAGE PLOTTER is being used to measure the force exerted by tethered swimmers.
- PRECISION TIMER II is being used to study nocturnal activity of caged animals.
- PRECISION TIMER II is also being used to measure the power exerted by human muscles as part of a thesis project by a Physical Education major.
- Several people are using TEMPERATURE PLOTTER to monitor the temperature of their hot tubs.
- The Stepper Motor project from *How to Build a Better Mousetrap* is being used to run a fish feeder for steelhead trout fingerlings.

◊ **Future Projects**: Vernier Software's future plans include: Upgraded ProDOS versions of TEMPERATURE PLOTTER and VOLTAGE PLOTTER, and (forgive me!) possible conversion of some of our programs to IBM. If you have suggestions or improvements you would like to see built into any of these projects, we hope you will let us know.

## Science Humor

◊ When asked why the town council of Pisa, Italy had voted money to have a large clock installed in the Leaning Tower, the head councilperson replied: "What's the use of having the inclination if you don't have the time?"

◊ Overheard conversation between an experimentalist and a theoretician at a university physics department:

Experimentalist: "Well, it took three months and our whole equipment budget, but our polarization experiment finally showed that scattering angle **A** is greater than scattering angle **B**."
Theoretician: "Really, I could have shown that from theoretical considerations in half the time."
Experimentalist: "Oh, no...what I meant to say was that angle **B** is definitely bigger than angle **A.** "
Theoretician: "Well, that is even easier! I could explain that in a day!"

◊ Three brothers went out West to establish a cattle ranch, but couldn't think of an appropriate name for it. So, they wrote to their father back East, and he replied, "Call it Focus, for that's where the sun's rays meet." [This triple pun comes from *Isaac Asimov's Treasury of Humor.*]

◊ There is new evidence that the dinosaurs did not die when a giant meteor struck the earth. They just got sick to death of trying to learn all of their long names.

◊ Speaking of dinosaurs: The museum guard proudly told the visitors that the dinosaur bones on display were "60,000,005 years old." When asked how the age could be known so precisely, the guard said, "I don't know how they do it, but when I started to work here five years ago, they told me that the dinosaur was 60 million years old. [This one seems to me to be a perfect example to mention to students when discussing "significant figures." It comes from John McGervey's book, *Probabilities in Everyday Life*. Professor McGervey teaches Physics at Case Western Reserve University. His book is full of interesting information and statistics on everything from gambling to seat belts to nuclear weapons.]

## Notes from the Marketing Department

The response to GRAPHICAL ANALYSIS III has been great! Everyone has been pleased with the improvements and for $24.95 (which includes a site license), you can't go wrong. Don't forget that you can upgrade your GRAPHICAL ANALYSIS II program for $10.00 by sending your old disk to us with your order. You will get a new disk and manual.

Did you happen to see the review of our *How to Build A Better Mousetrap and Thirteen Other Projects Using the Apple ® II* written by Marvin De Jong in the May 1987 issue of *The Physics Teacher*?

Do you have a nonworking photogate system, temperature probe system or whatever? Have you tried to troubleshoot it to no avail? Don't frustrate yourself any further. Stick it in a box and send it to us. We will look it over and either fix it or let you know what is wrong. We want happy customers, not frustrated ones.

If you would like a batch of our catalogs and/or newsletters for any workshops you are conducting this summer, give us a call.

**Upcoming Conferences:** For the sixth consecutive year will have a booth at the AAPT summer meeting. This year's meeting will be in Bozeman, Montana on June 17-19. This Fall we will be attending "A Symposium On Microcomputer Based Laboratories" in Omaha on October 29-31 and two NSTA regional meetings: Pittsburgh and San Antonio. If you plan to attend any of these conferences, we hope you will stop by our booth.

## Vernier Software Newsletter Response Form - Spring 1987

☐ Please send me information on the following items mentioned in the newsletter:

_____

_____

_____

☐ Please send me a catalog of your products.

☐ Please send me ___ Game Port Extenders @ $16.00 (shipping included).

P.O. # _____

Your Name _____
School _____
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